for x, the independent variable. For instance, to substitute 4 for x in the quadratic function $f(x) = -x^2 + 5x + 3$, you would write

$$f(4) = -4^2 + 5(4) + 3 = 7$$

The symbol $f(4)$ is pronounced "f of 4" or sometimes "f at 4." You must recognize that the parentheses mean substitution and not multiplication.

This notation is also useful if you are working with more than one function of the same independent variable. For instance, the height and velocity of a falling object both depend on time, t, so you could write the equations of the two functions this way:

$$h(t) = -4.9t^2 + 10t + 70 \quad \text{(for the height)}$$

$$v(t) = -9.8t + 10 \quad \text{(for the velocity)}$$

In $f(x)$, the variable x or any value substituted for x is called the **argument** of the function. It is important to distinguish between f and $f(x)$. The symbol f is the *name* of the function. The symbol $f(x)$ is the y-value of the function. For instance, if f is the square root function, then $f(x) = \sqrt{x}$ and $f(9) = \sqrt{9} = 3$. Note that the reflexive axiom, $x = x$, requires that you substitute the same number for x everywhere it appears in an expression or equation. It would be improper format to write $f(x) = \sqrt{9}$ if you have substituted 9 for x.

Names of Functions

Functions are named for the operation performed on the independent variable. Here are some types of functions you may recall from previous courses, along with their typical graphs. In these examples, the letters a, b, c, m, and n stand for **constants.** The symbols x and $f(x)$ stand for **variables,** x for the independent variable and $f(x)$ for the dependent variable.

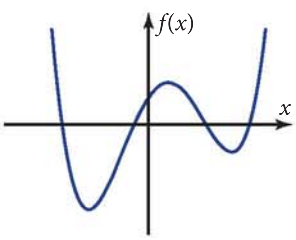

Figure 1-2c

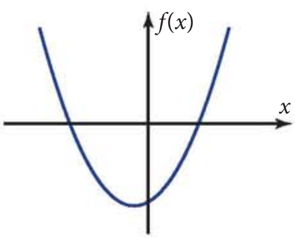

Figure 1-2d

- **Polynomial function,** *Figure 1-2c*

  General equation: $f(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$, where n is a nonnegative integer

  Verbally: $f(x)$ is a polynomial function of x. (If $n = 3$, f is a cubic function. If $n = 4$, f is a quartic function.)

  Features: The graph crosses the x-axis up to n times and has up to $n - 1$ vertices (points where the function changes direction). The domain is all real numbers.

- **Quadratic function,** *Figure 1-2d* (a special case of a polynomial function)

  General equation: $f(x) = ax^2 + bx + c$, $a \neq 0$

  Verbally: $f(x)$ varies quadratically with x, or $f(x)$ is a quadratic function of x.

  Features: The graph changes direction at its one vertex. The domain is all real numbers.